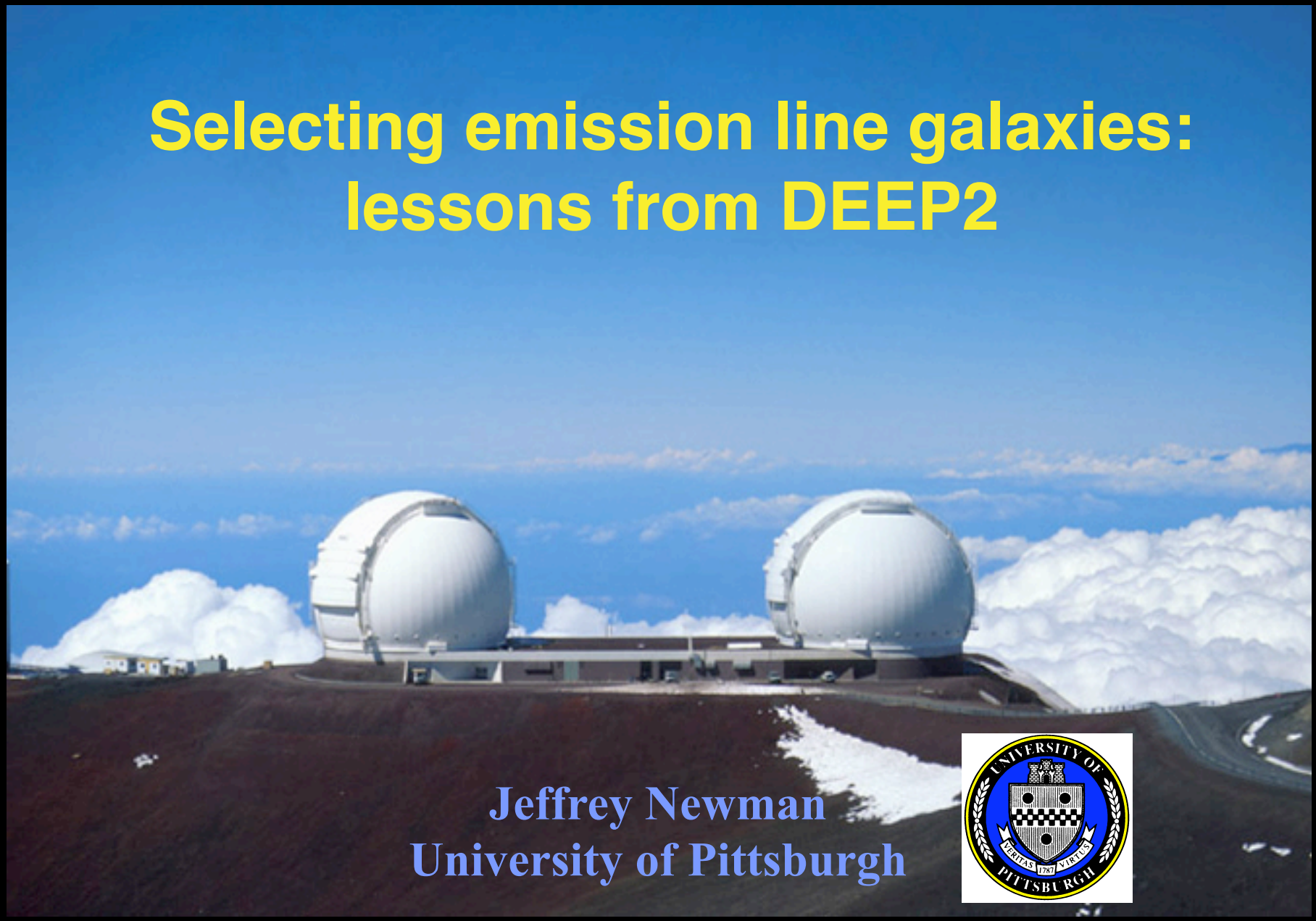
Selecting emission line galaxies: lessons from DEEP2



Jeffrey Newman
University of Pittsburgh

Nov. 2009

Outline

I. Target selection in DEEP2

II. Confronting redshift failures

III. Bias of bright blue galaxies at z~1

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DEEP2: A Redshift Survey at z~1

DEEP2 (= DEEP Extragalactic Evolutionary Probe 2) was designed to study both galaxy properties and large-scale structure at z~1.

U.C. Berkeley

M. Davis (PI)

U.Pitt.

J. Newman

UCSD

A. Coil

Steward Obs.

M. Cooper

B. Weiner

C. Willmer

Toronto

R. Yan

U.C. Santa Cruz

S. Faber (Co-PI)

D. Koo

P. Guhathakurta

A. Phillips

K. Noeske

A. Metevier

L. Lin

J. Harker

G. Graves

Stanford

B.Gerke

Princeton

C. Conroy

Harvard

D. Finkbeiner

U. Washington

A. Connolly

U. Hawaii

N. Kaiser

Gemini

R. Schiavon

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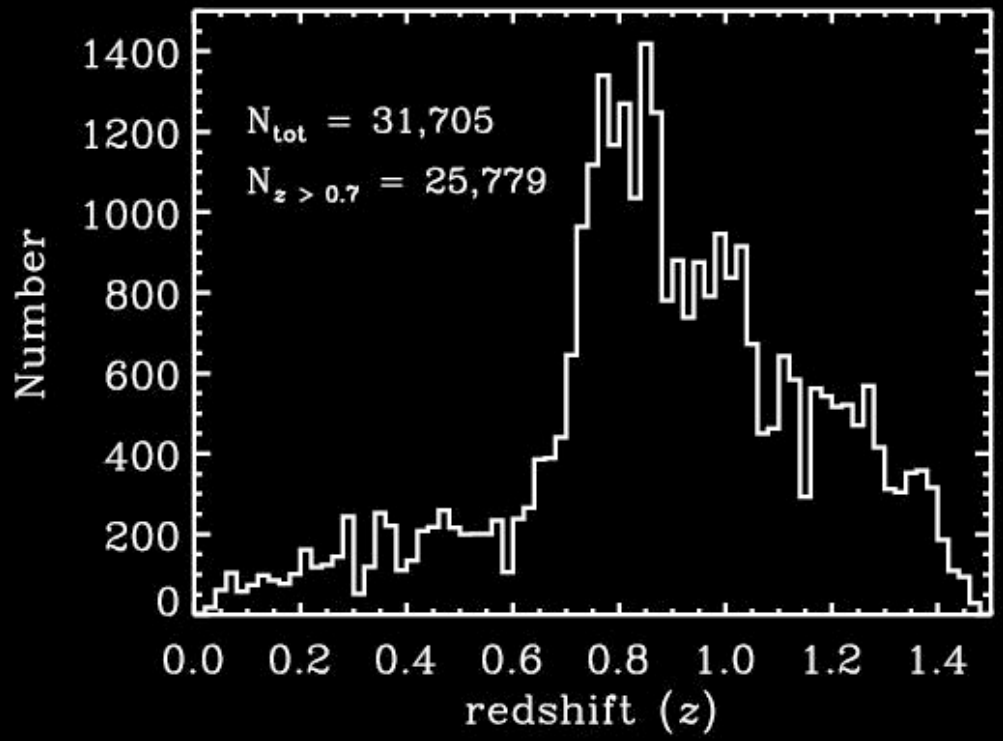
Vital statistics of DEEP2

- **Observational details:**
- ~3 sq. degrees
- 4 fields (0.5º x <2º)
- RAB ≤ 24.1
- 80+ Keck nights
- >33,000 redshifts
- primarily 0.7 < z < 1.4
  - (pre-selected using BRI photometry)



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DEEP2 was made possible by DEIMOS, a new instrument at Keck

A massive (10 ton) new instrument, the DEIMOS spectrograph (PI: Faber), was designed specifically for DEEP2. A grant of 80 nights' observing time from the University of California has brought DEEP2 to fruition.

All DEEP2 data have been released!

http://deep.berkeley.edu/DR3

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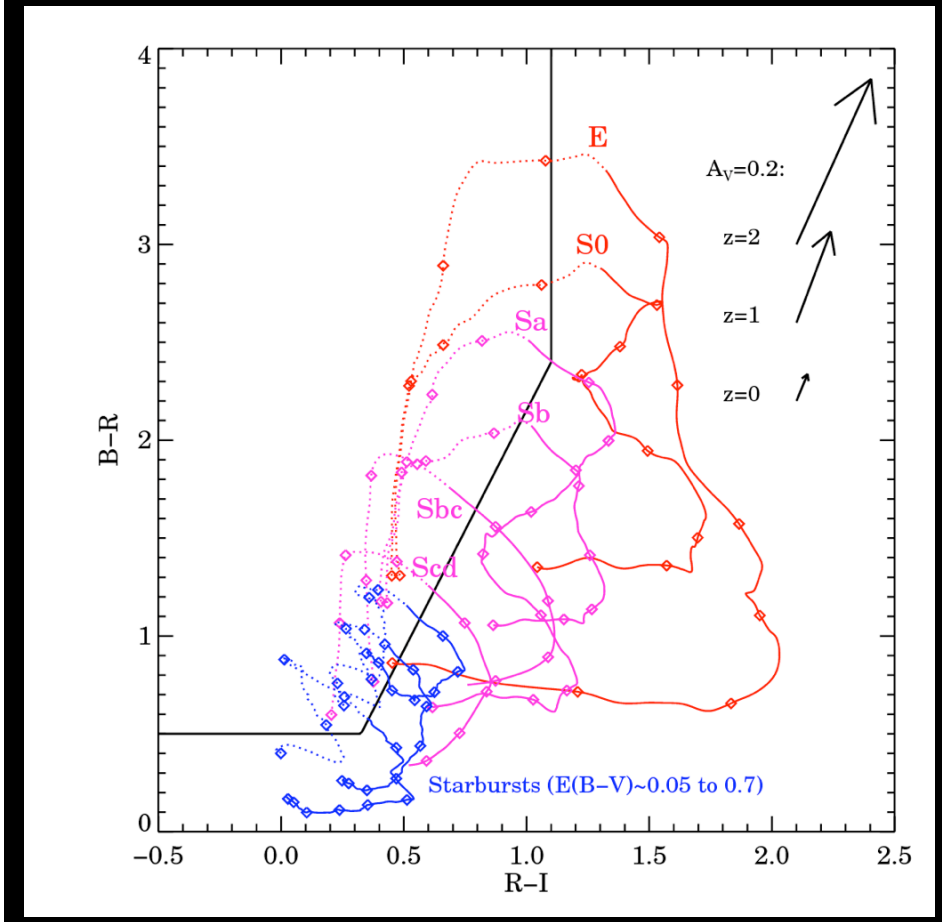
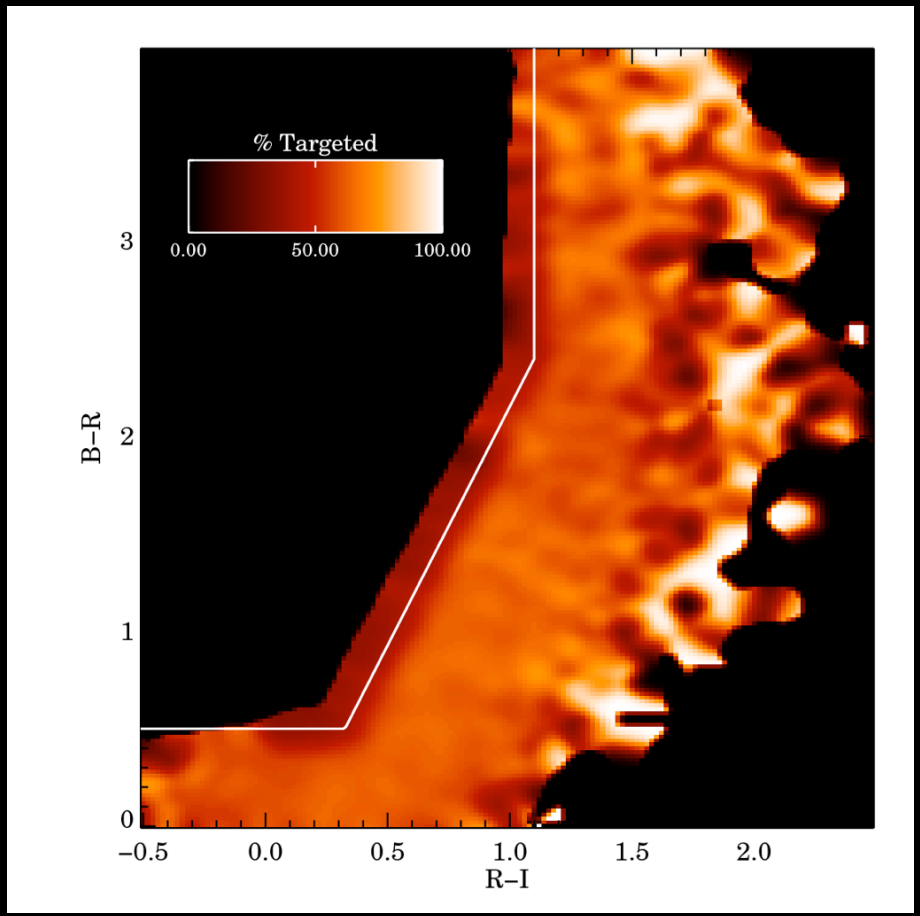
DEEP2 pre-selects high-z galaxies using observed colors



First guess: CWW/Kinney-Calzetti



Final cut: refined with DEEP1+PEEP (177 galaxies), + 1st semester's data

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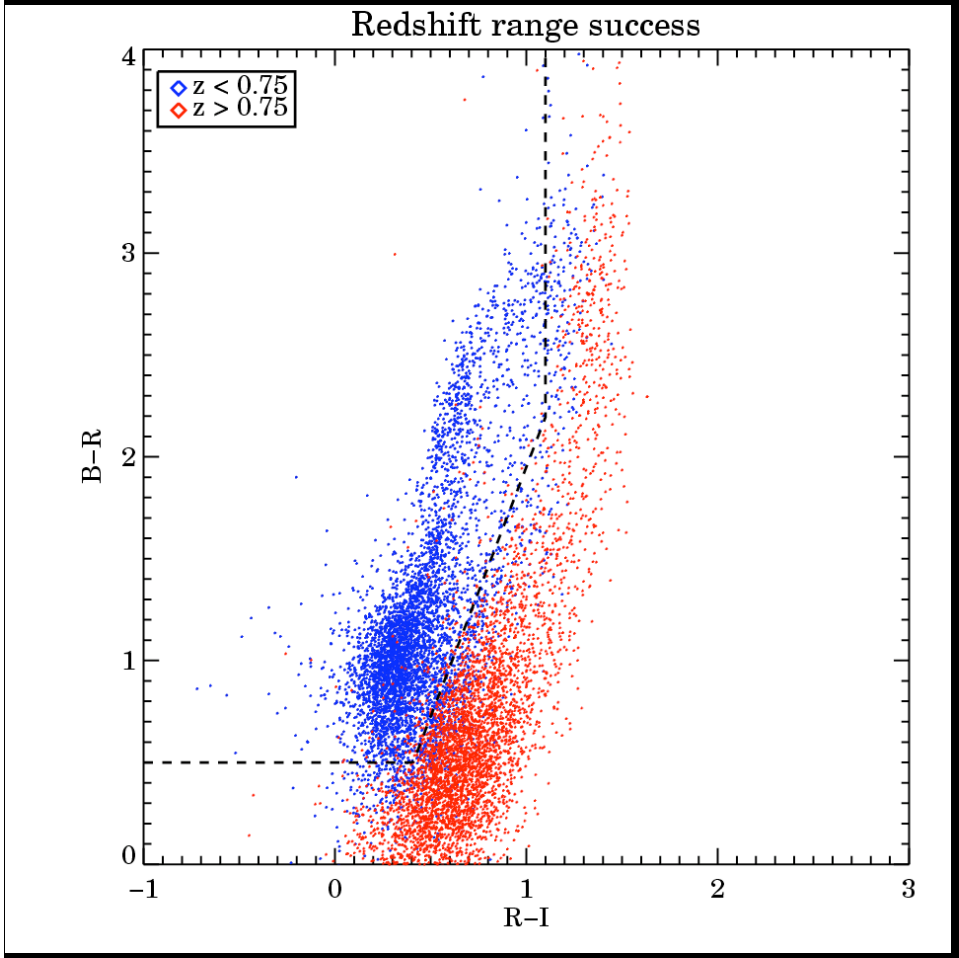
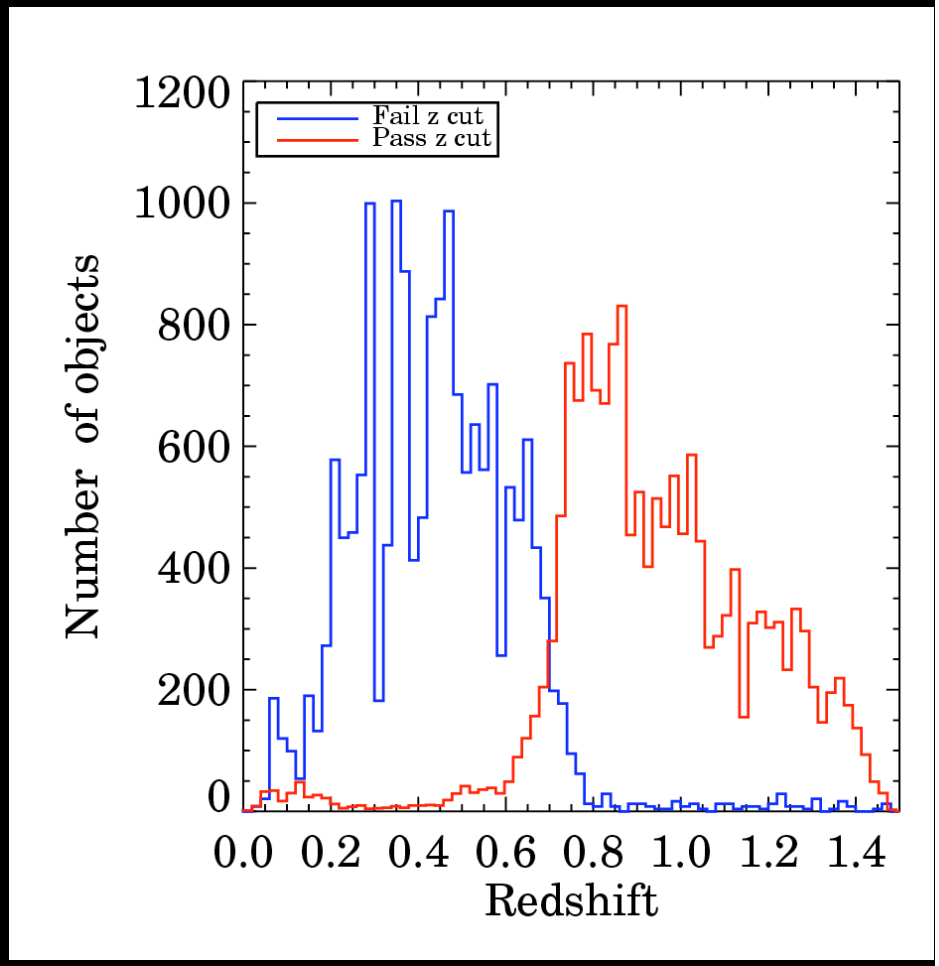
BRI color cut was highly successful





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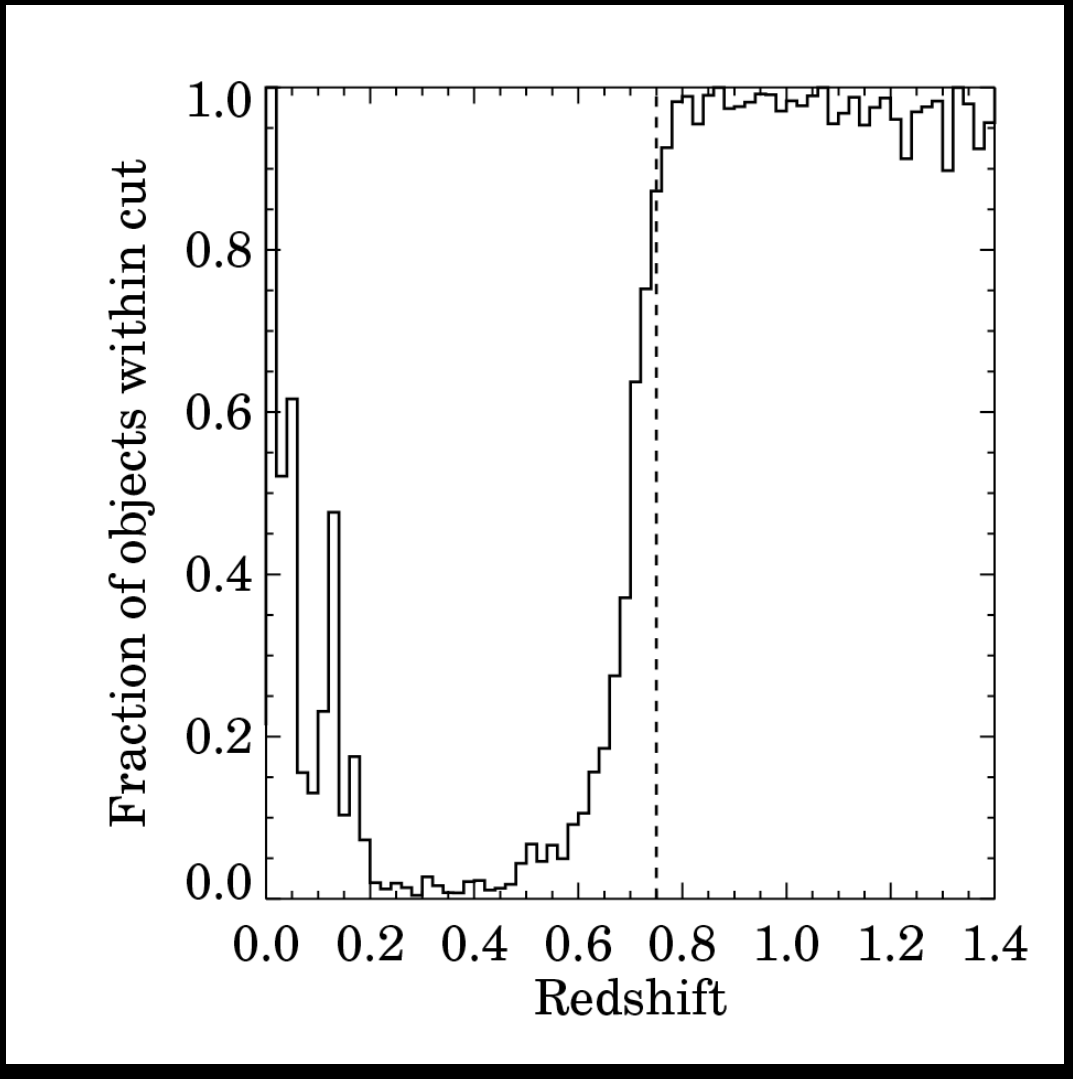
DEEP2 color cuts give very efficient selection



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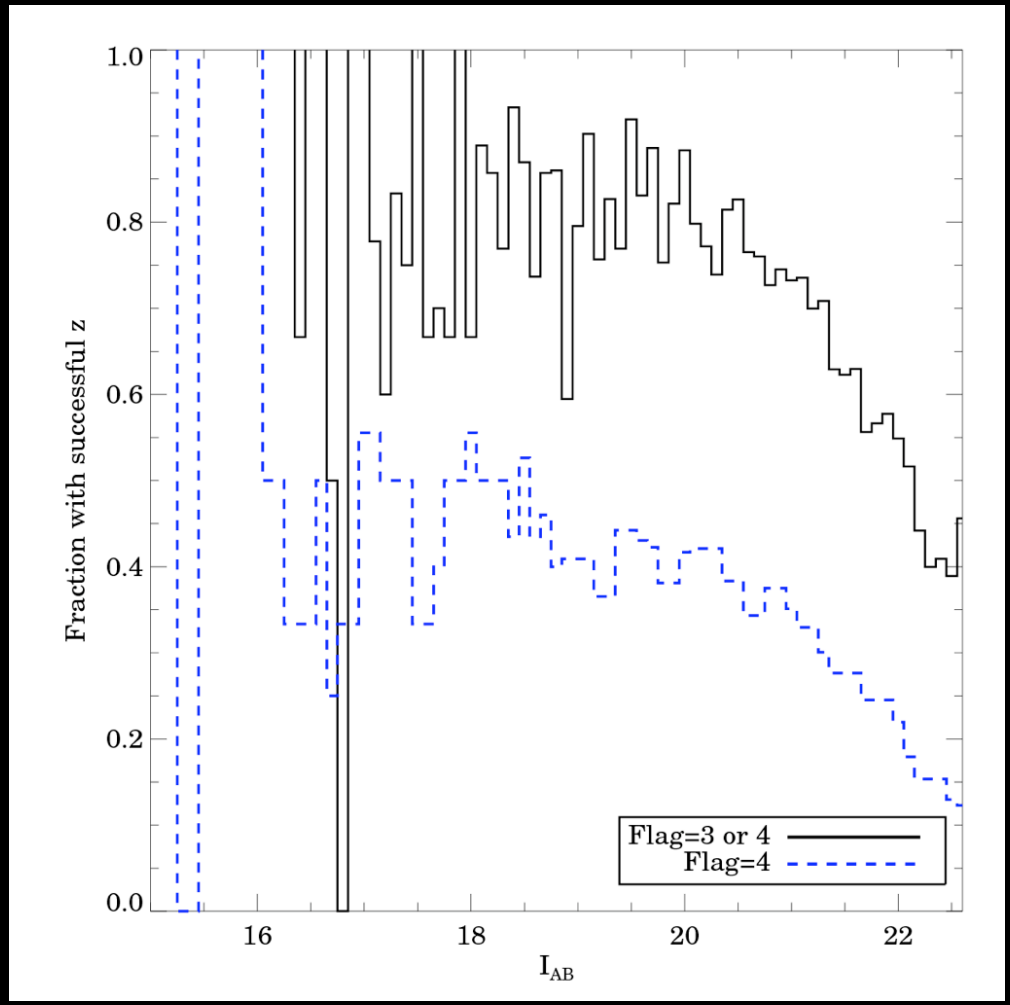
Redshift success rates will be an issue

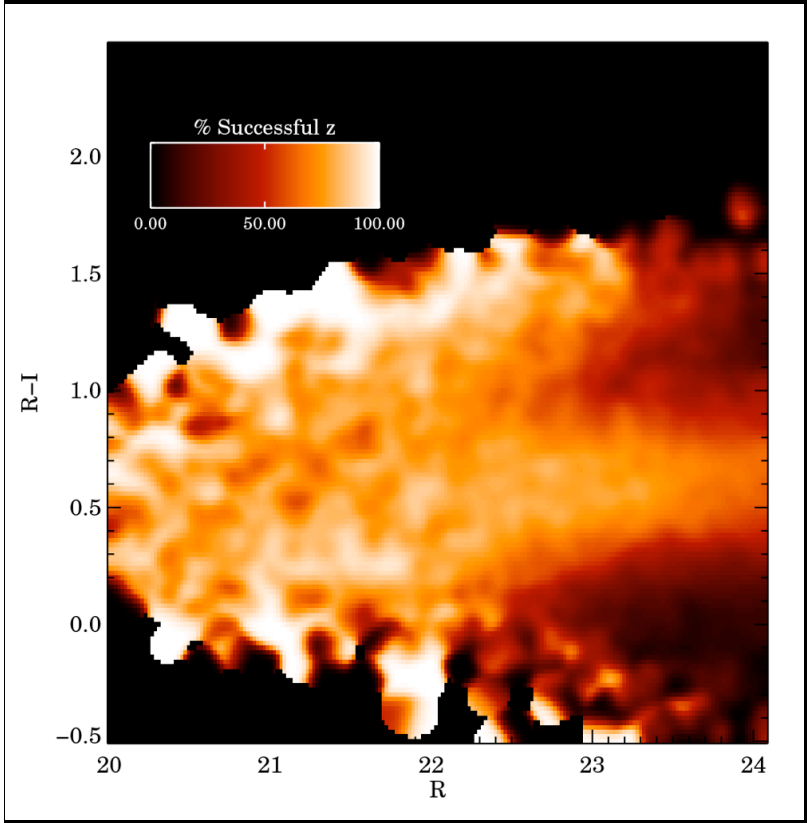
Need to consider redshift success rates in optimizing design

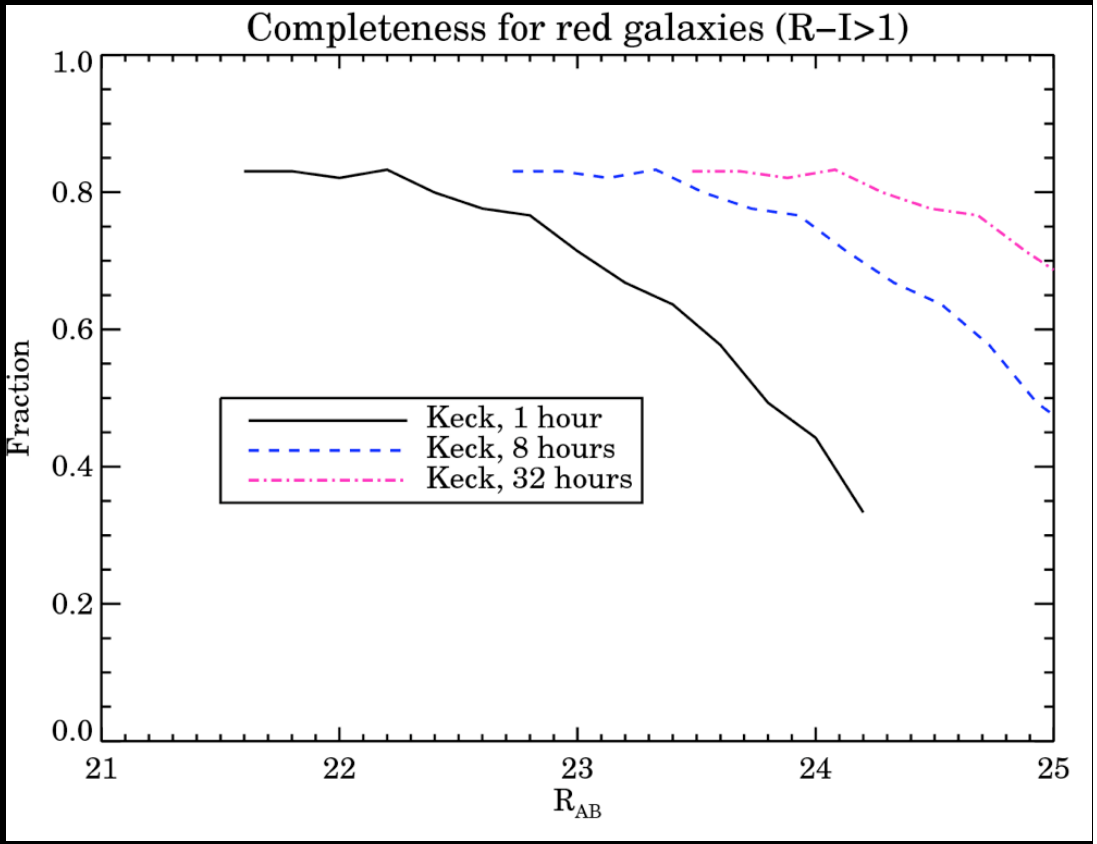
e.g. zCOSMOS-bright: Redshift success is a strong function of magnitude.



June 2009

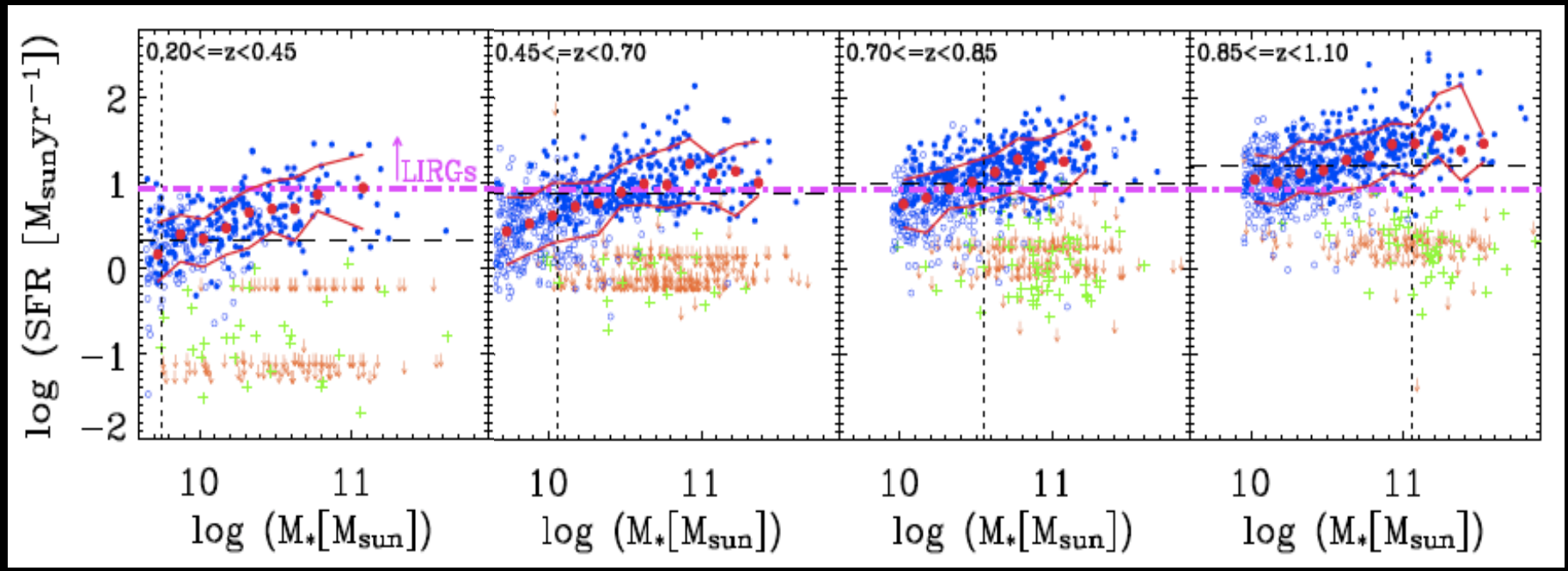
In DEEP2, redshift success is ~flat for blue galaxies, drops for red





April 2009

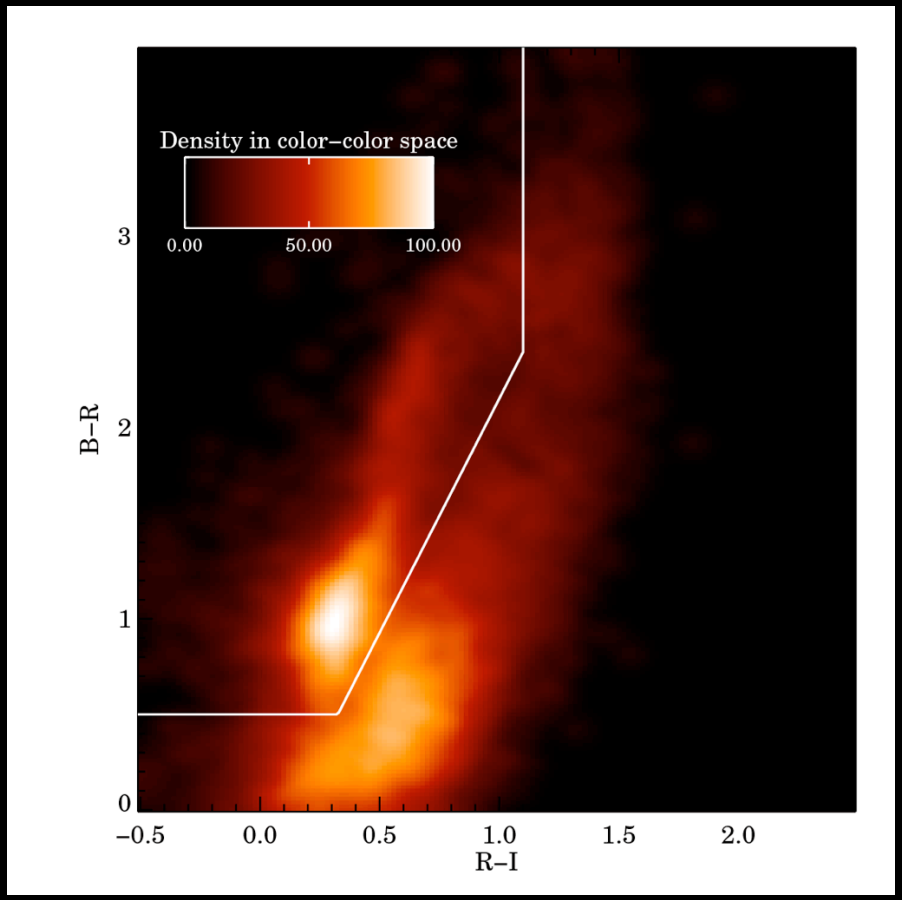
Little luminosity dependence in z success as SFR/line luminosity is a slow function of mass



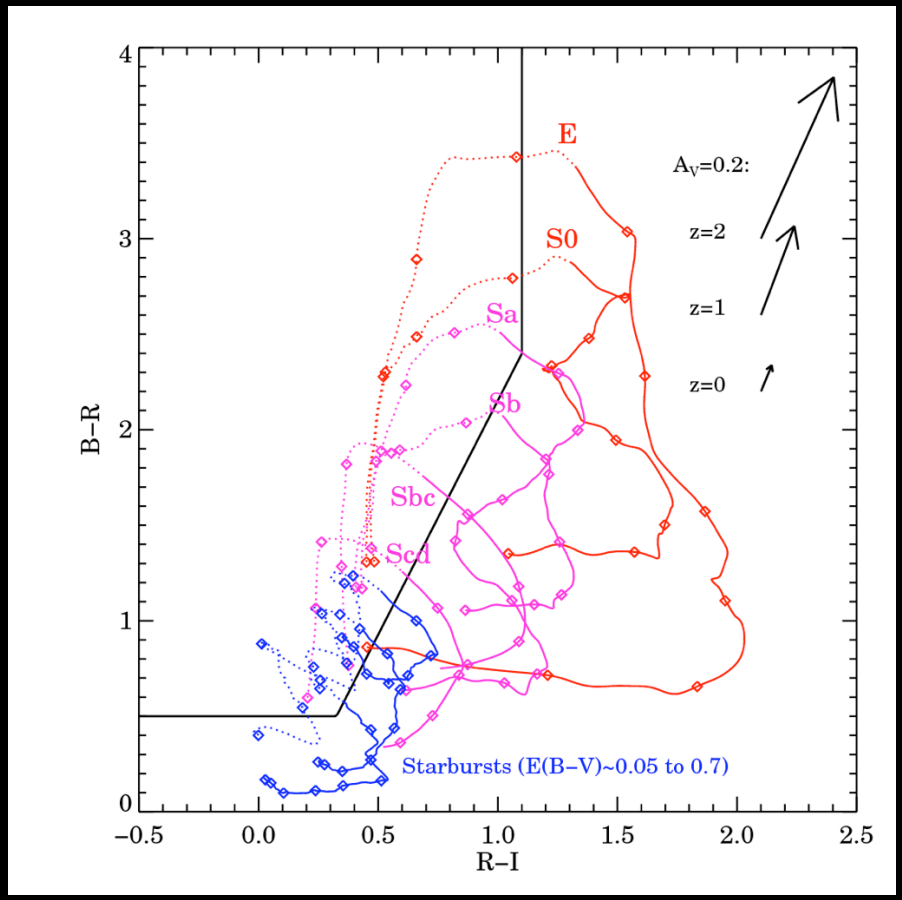
Noeske et al. 2007

Nov. 2009

Redshift Success in DEEP2 color-color diagrams



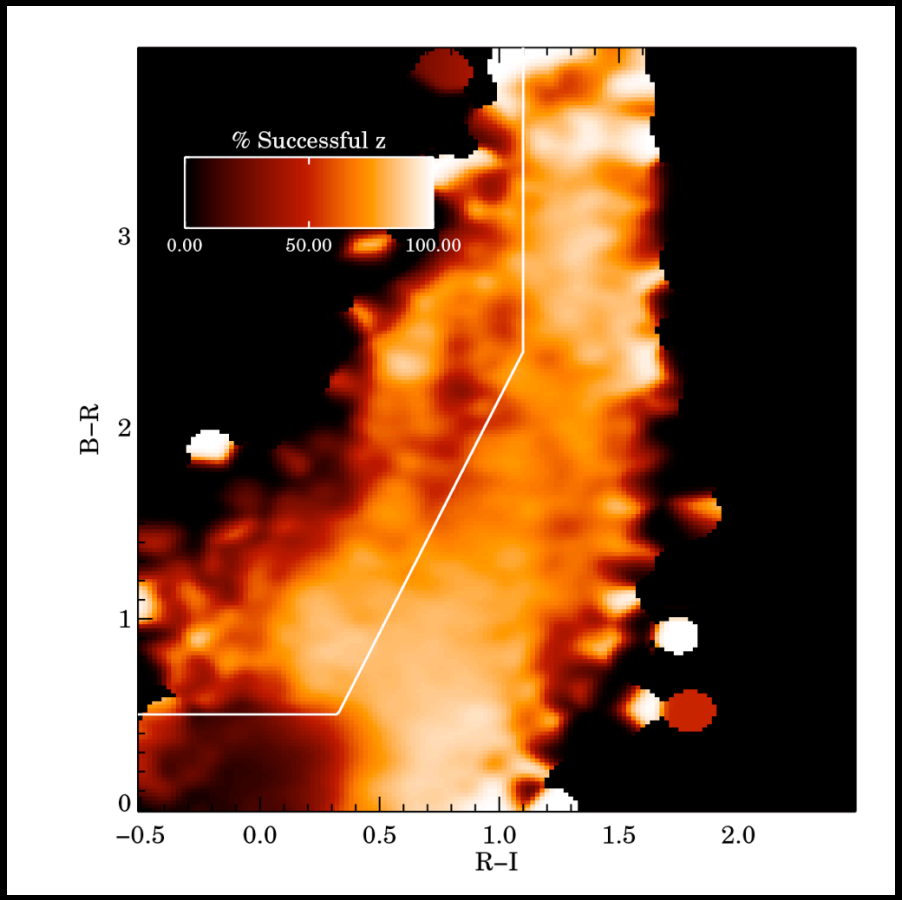
Observed color-color diagram for DEEP2 targets (in EGS, so no color cut)



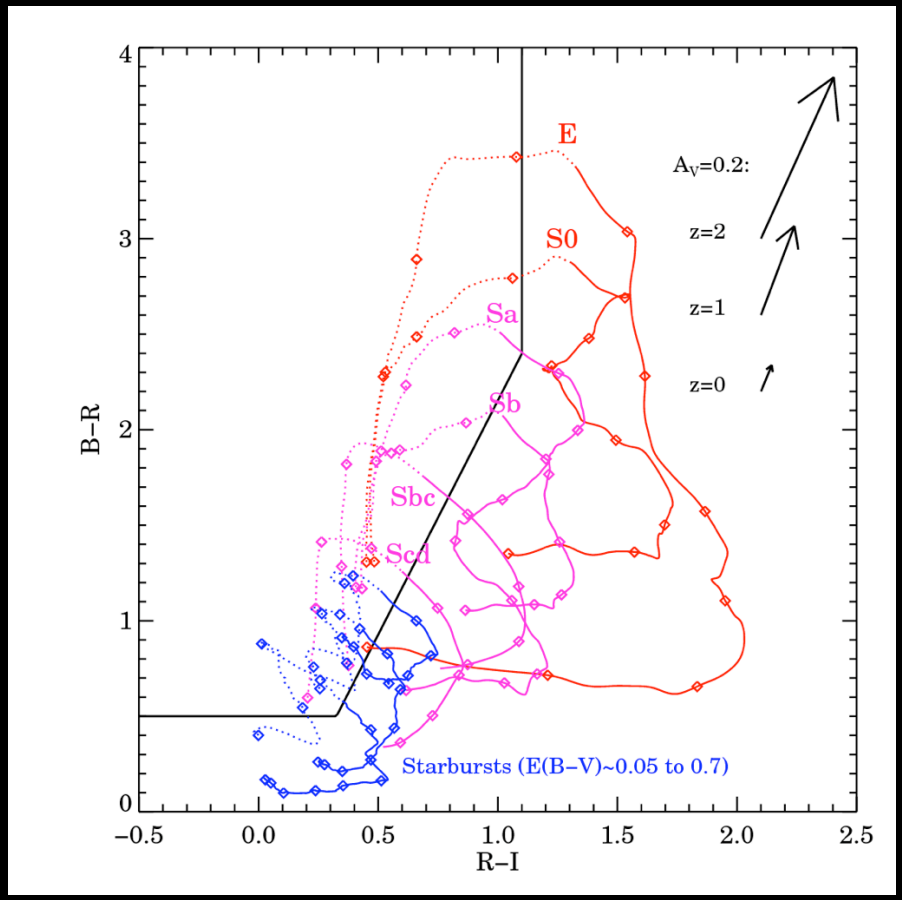
CWW tracks through CMD (dot-solid transition at z=0.7, diamonds every 0.2 in *z*)

June 2009

Redshift Success in DEEP2 color-color diagrams



Success (Q=3 or 4) rate for DEEP2; <90% in best regions



CWW tracks through CMD

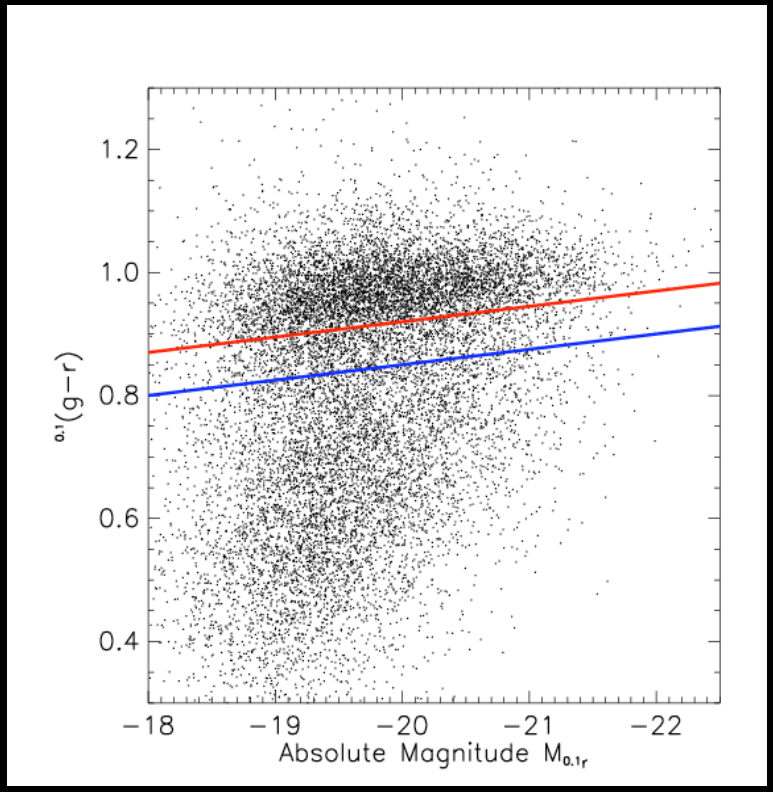
June 2009

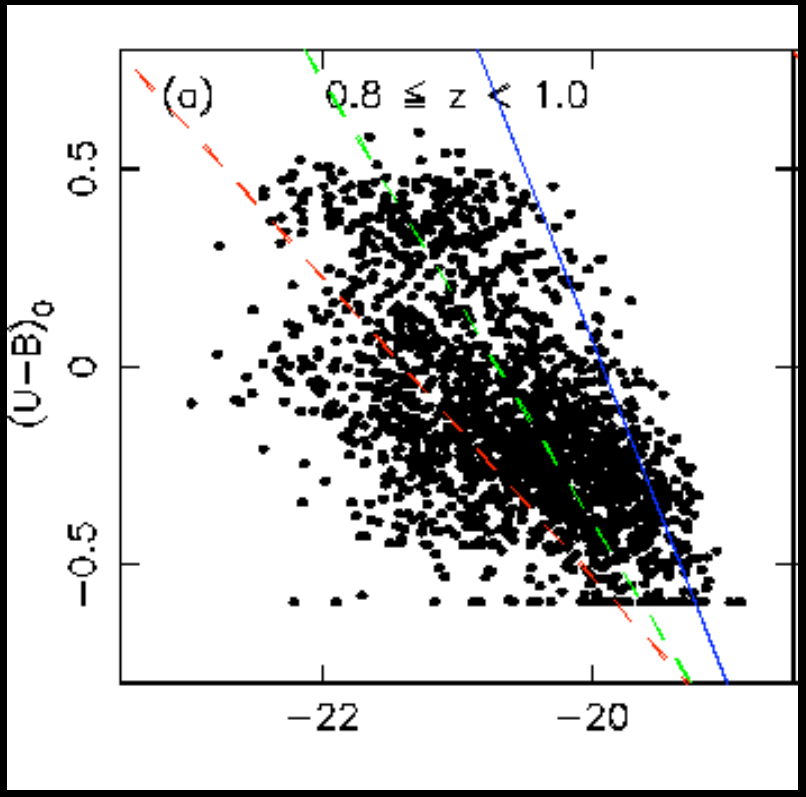
Bias of bright blue galaxies at z~1

SDSS, z~0.1

DEEP2, z~0.9

redder





brighter ⟶

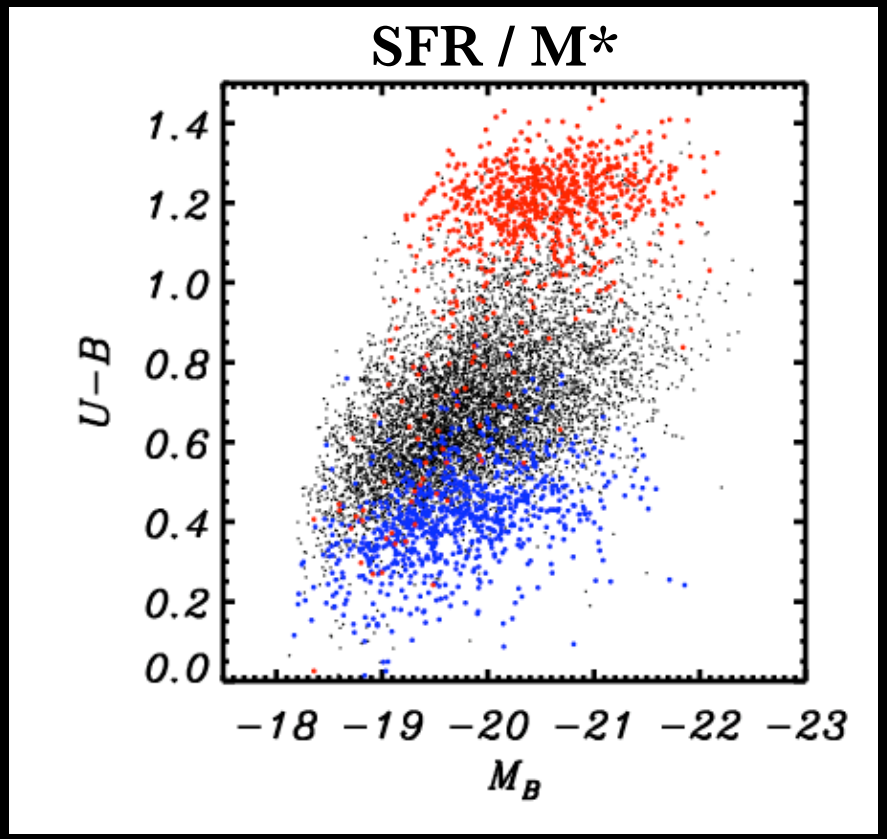
⟵ brighter

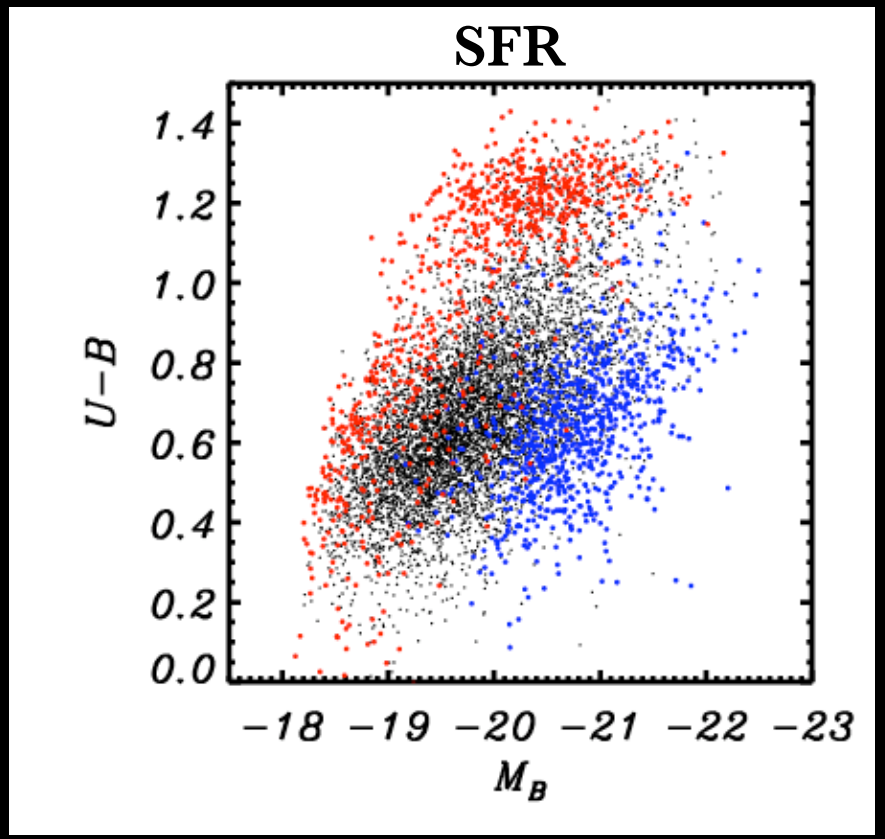
Willmer et al. 2005

Nov. 2009

Highest SFR/highest-emission objects are bright and blue

top 10% & bottom 10%

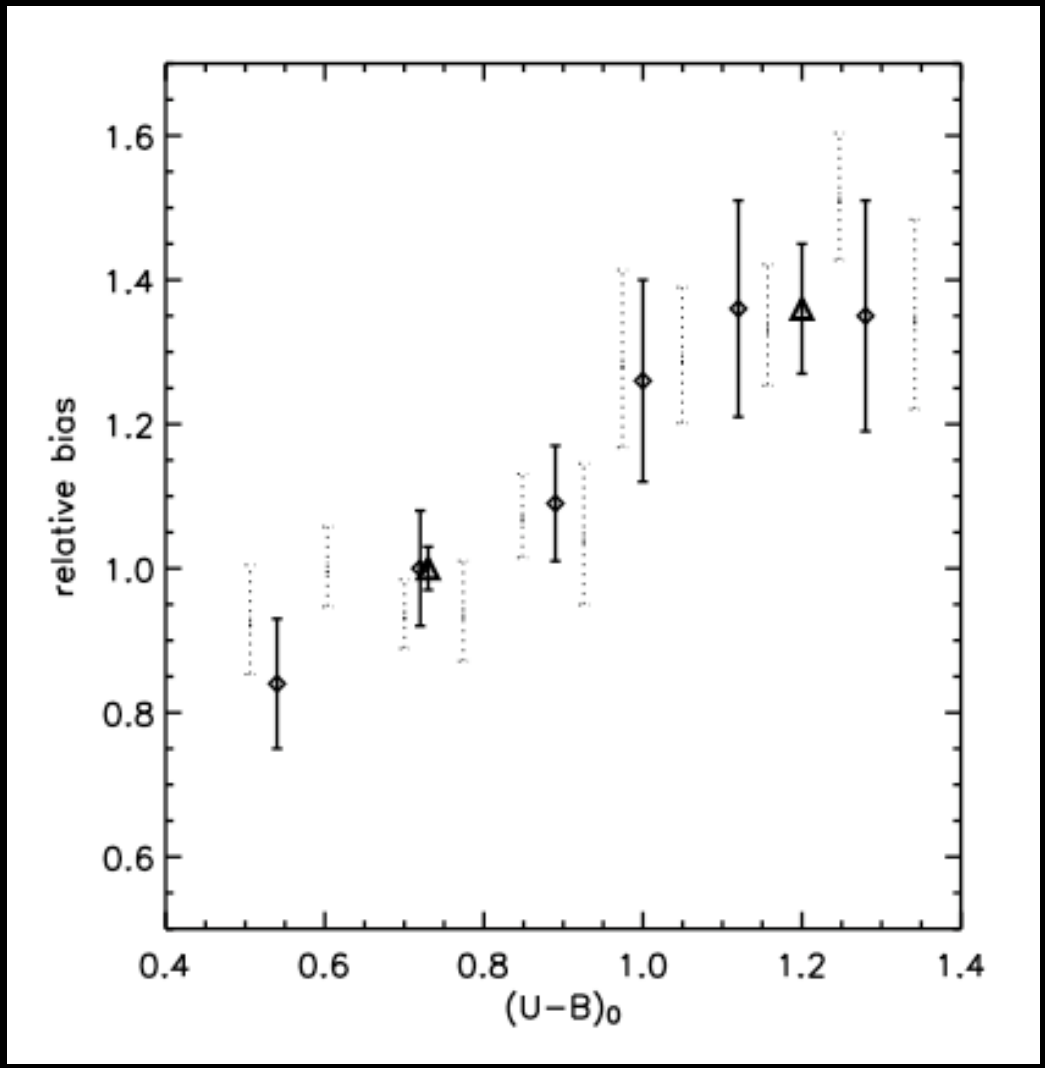




Cooper et al. 2007

Nov. 2009

Environment (overdensity) effectively is large-scale structure bias on ~2 Mpc

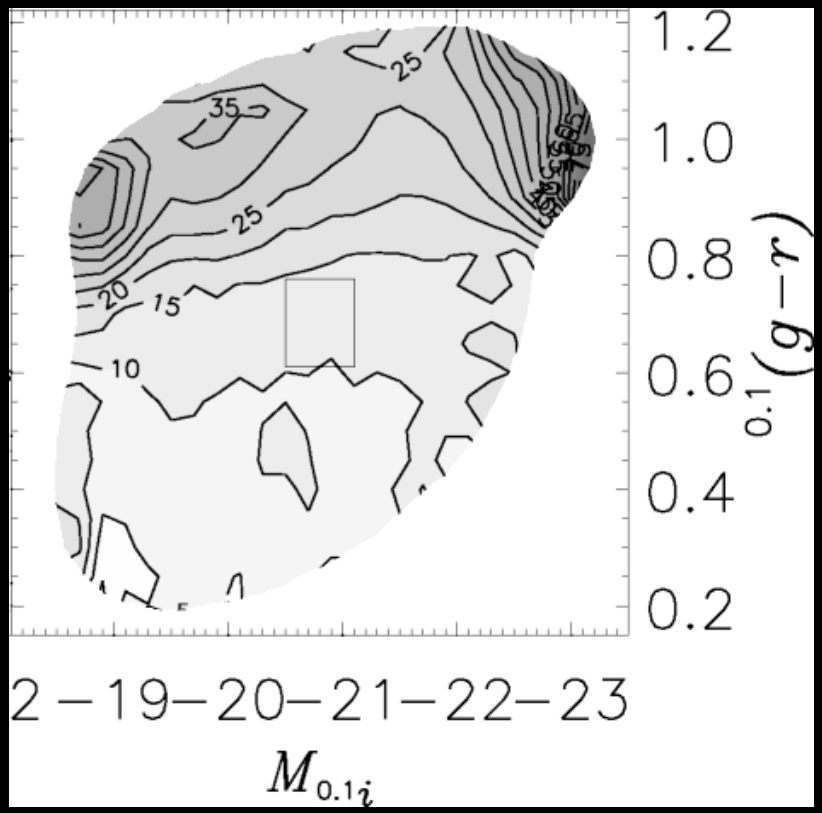


The environment measure we use (projected 3rd-nearest-neighbor overdensity, $<1+\delta_3>$) corresponds closely to the bias determined from DEEP2 correlation function measurements (but errors are smaller / can break samples into finer bins).

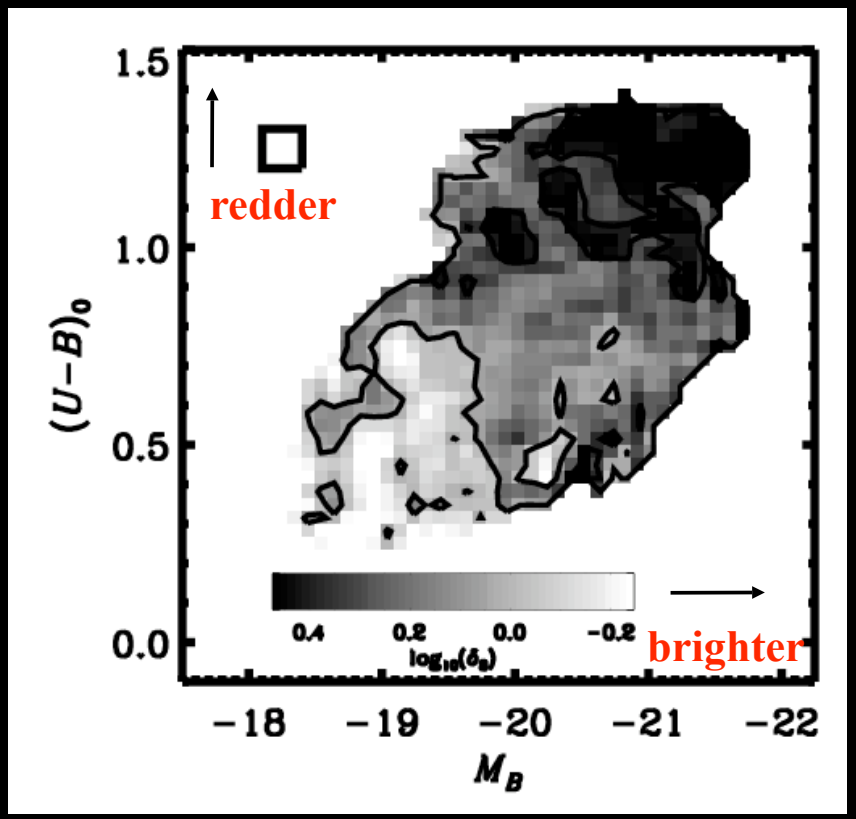
Coil et al. 2007 Nov. 2009

Environment over the CMD

SDSS, z~0.1



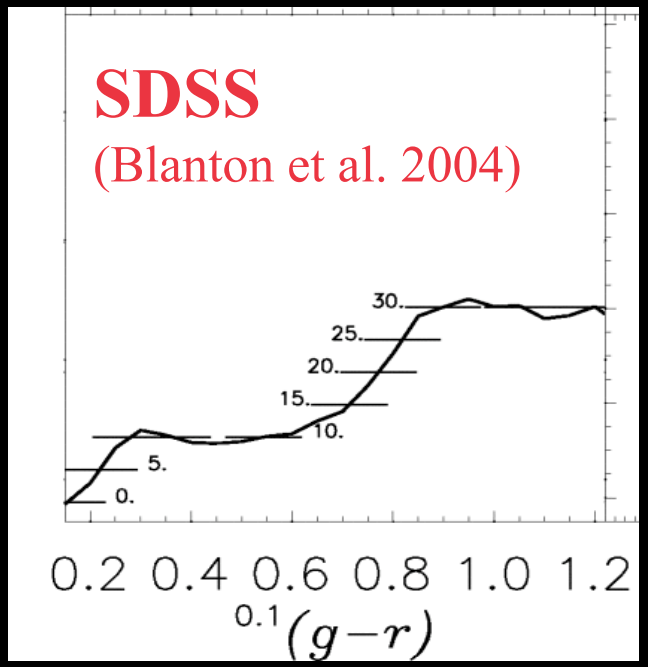
DEEP2, 0.75<z<1.05



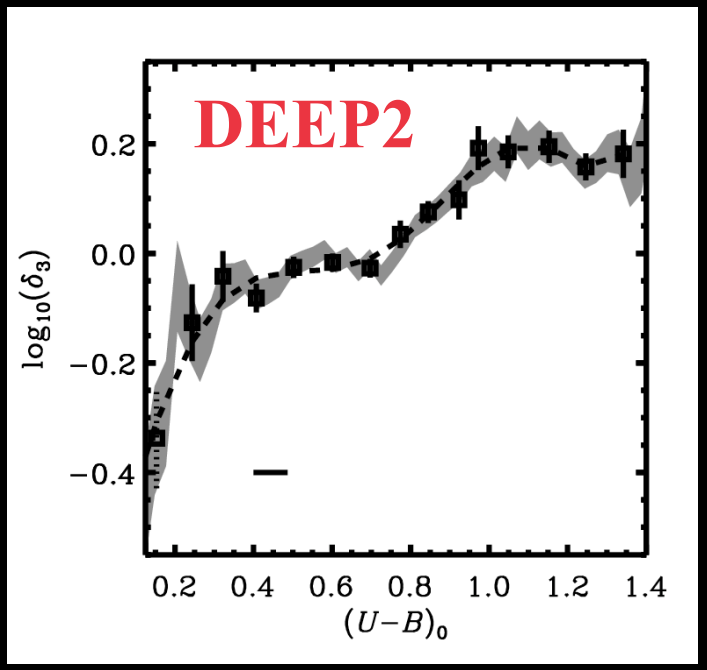
Overall, environmental trends for galaxy colors & luminosities look largely similar at z~0 and z~1: but bright blue galaxies have higher bias than today **Cooper et al. 2006**

The strongest environmental trend is for red galaxies to be found in dense environments

linear overdensity



blue color red



blue color red

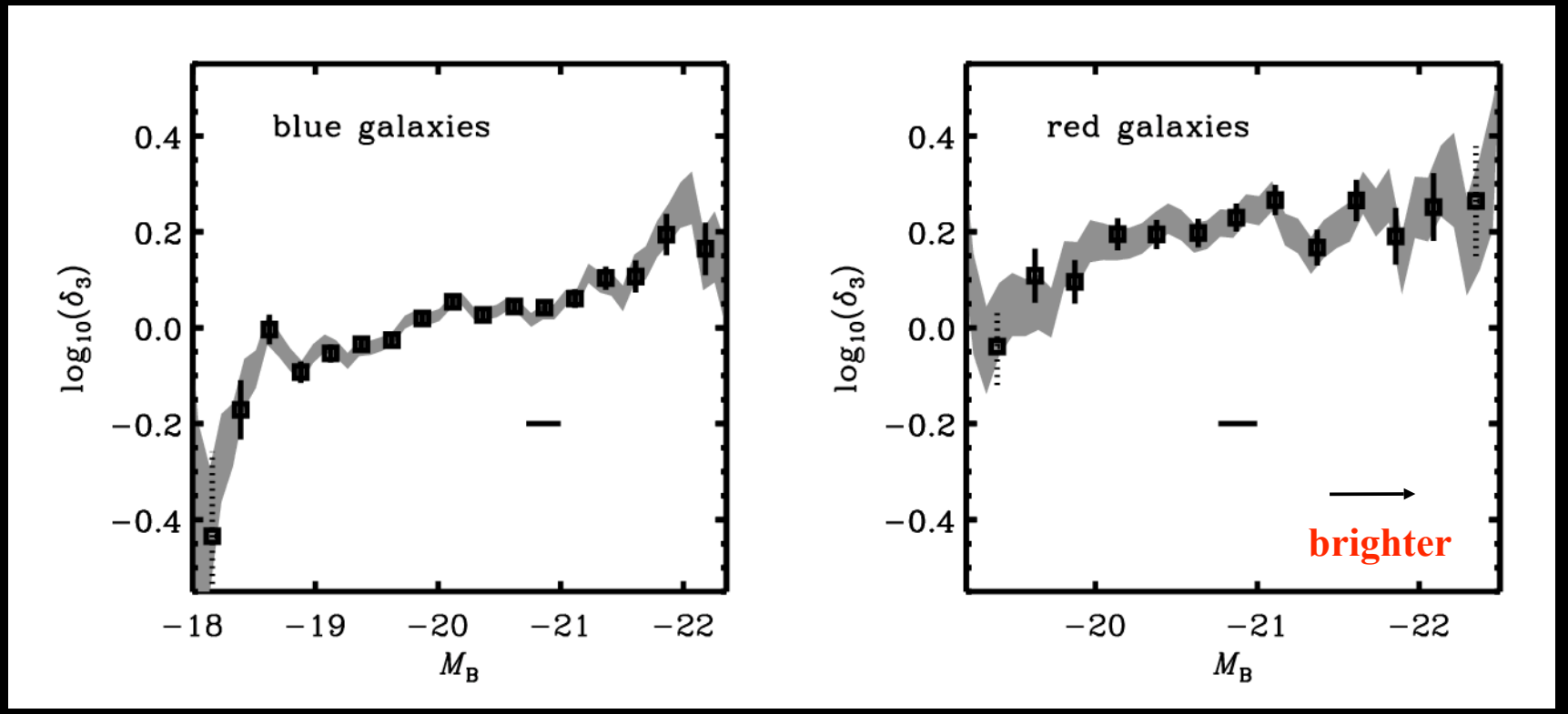
log overdensity

Cooper et al. 2006

Nov. 2009

Environment vs. Luminosity

Blue galaxies **Red galaxies**

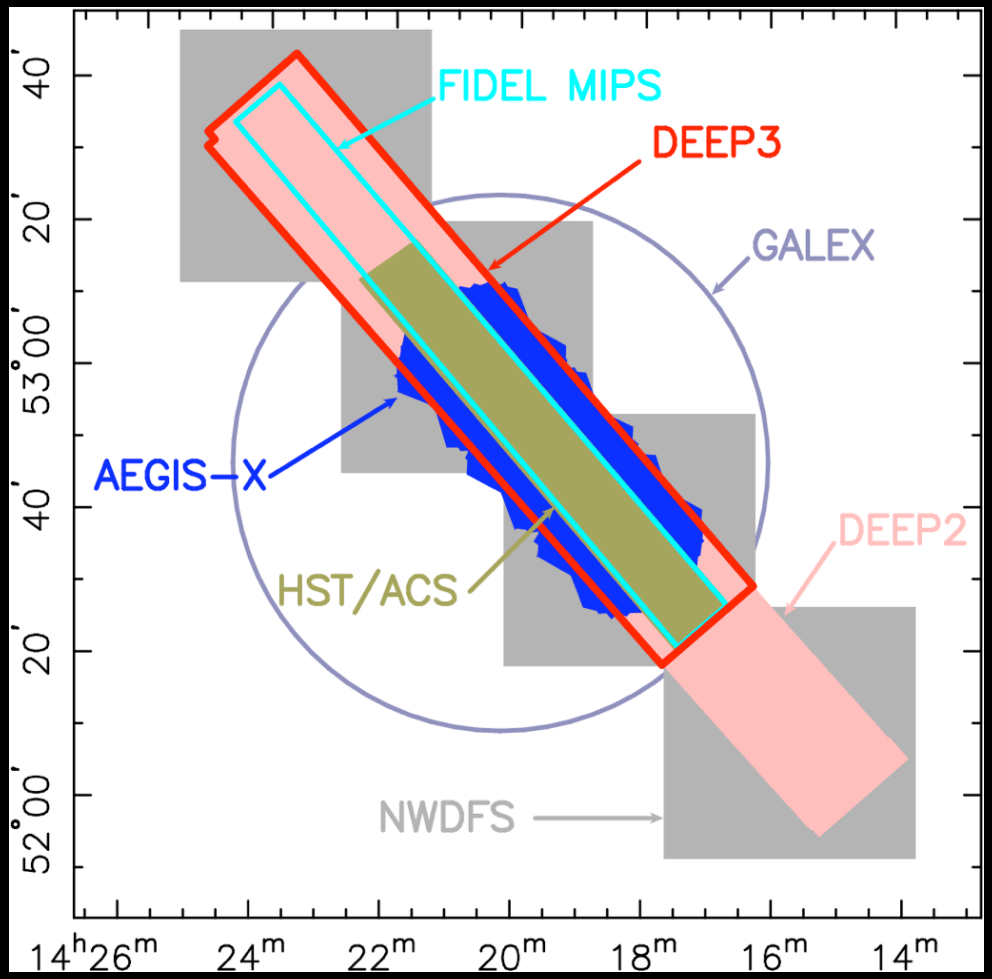


Unlike locally, red and blue galaxies have very **similar** trends of environment vs. luminosity at *z*~1: massive blue galaxies *in dense environments* became red by z~0

Cooper et al. 2006

Nov. 2009

DEEP3



- **18k new spectra, EGS only**
- **Target the 40% of R_{AB}<24.1 objects DEEP2 missed, plus:**
  - All FIDEL *Spitzer* 70μm sources
  - All *Chandra* sources down to R_{AB}~24.5
  - "Faint extension" of star-forming galaxies down to R_{AB}~25.5
- **Granted 23 nights & long-term status from UC TAC**

Nov. 2009

Conclusions

- Color selection was highly effective for DEEP2, but sorting out low-luminosity low-z galaxies from luminous z~2 galaxies is hard
- Need to consider redshift success as well as redshift range in designing optimized samples
- Bright ($M_B + 5 \log h < -21$) blue galaxies in DEEP2 have bias ~1.4+/- 0.2 (for σ_8=0.9) at z~0.8; r_0 ~4.3+/- 0.4 h^{-1} Mpc comoving, γ~1.75+/-0.05 (Coil et al. 2007). These numbers become b~2, r_0~5.75 for $M_B + 5 \log h < -22$ (Cooper et al. 2007).
- Many new results from DEEP2, DEEP3, & AEGIS soon!
- Look for DEEP2 DR4 & survey paper (Newman et al.) in 2010

New data releases!
http://deep.berkeley.edu/DR3
http://aegis.ucolick.org

Nov. 2009